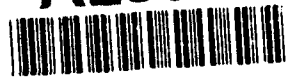


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TECHNICAL REPORT

August 15, 1994

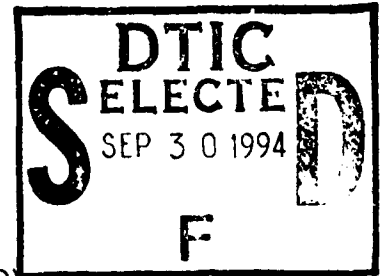
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Substrates Multichip  
Modules"

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In this quarter we have

- ## 75kW Reactor

Microwave transmission line modifications were installed which reduced the reflected power to about 1%, allowing full power transmission and coupling to the plasma. At these low reflected powers, the heating of wave guide components is minimal, and the reliability and MTBF of these components is optimized.

The 75kW transmitter modifications have proven extremely successful, with robust power control and improved filament life resulting from optimizing the control systems.

We have continued to develop diamond growth process in conventional (H<sub>2</sub>, CH<sub>4</sub>, O<sub>2</sub>) chemistries from our prototype to the 75kW reactor. Operation at 40-45 kW with lower reflected power scales as projected to yield throughputs in the 500 mg/hr range.

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material has successfully released the diamond sample on 1" diameter test coupons. Studies are continuing on 6" and 8" molybdenum and other modified materials.

### ***Thermal Probe***

We have purchased the design of an existing thermal conductivity test stand. This design uses the thermal wave technique for a noise immune "phase-lag" measurement of the in-plane thermal diffusivity. The use of an existing and proven design will allow faster time to full operation and utility in the MCM program, and better bench marking with other measurement techniques. The long lead items have been ordered, and fabrication of custom components begun.

### ***Reactor Prototype Related Studies***

We are continuing to study high growth rate (HGR) process in our PDS19 reactor, the prototype for the 75kW system, operating at 8kW and 2.45 GHz. Recent efforts have concentrated on design and testing of real-time temperature control hardware utilizing novel substrate mounting pucks and stage modifications. The size and shape of the substrate puck are crucial in that they interplay subtly with both the plasma and deposition effects as well as the heat removal profile. The results to date have scaled very successfully to the full sized designs in the AX6600, and have resulted in better substrate cooling, improved temperature uniformity, and real-time temperature control.

### ***Reactor Modeling***

The 2D modeling, using the GEM code, has been used quite extensively in the design of the stage rebuild as well as the substrate mounting puck modifications. The present version of the GEM code, which calculates the self-consistent electromagnetic and neutral particle effects, predicts the 2D profiles of all fields and particles of a hydrogen discharge. From this, the atomic hydrogen flux on the substrate can be calculated, and the profile optimized for uniformity and efficiency.

The success of the 2D code has been used to model possible alternate reactor geometry's for future development. Several such systems are of great interest:

- ® A compact 75kW system, with a single mode cavity, lower cost, and reduced substrate diameter,
- ® A modified reactor geometry with higher plasma area utilization,
- ® A larger scale system at lower frequency (around 250 MHz) and several hundred kW microwave power.

The continuing efforts on modeling are concentrating on further understanding and improving process on the 75kW system. As a support tool, the modeling is generally helping to determine ideal substrate mounting configurations and run conditions.